**Importation and Establishment of *Lygus hesperus* Nymphal Parasitoids**

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*Lygus hesperus* is a serious pest of several field crops across the United States. In California it causes about 30 million dollars in damage to cotton each year (Goodell, pers. comm.), and is a serious problem to growers of strawberries along the central coast of California at an estimated cost of 40.3 million dollars (www.ipm.ucdavis.edu, Zalom, pers. comm.). It is also a pest to numerous seed crops including alfalfa (UC Cooperative Extension 2000). Currently lygus is managed on most crops through applications of broad-spectrum insecticides. Cultural and biological alternatives are not considered useful. Although several natural enemies attack this pest, they are not economically effective. Importation of nymphal parasitoids in the eastern United States during the 1980's, successfully reduced *Lygus lineolaris* (a close relative of *L. hesperus*) infesting alfalfa. This project proposes doing the same for *L. hesperus* in central California. Lygus is highly polyphagous, moving between numerous plant species throughout the year. Therefore, one approach to reducing this pest's damage in cotton would be to reduce its densities in other preferred host plants. The objective is to reduce regional populations of *L. hesperus*, thus reducing the numbers that migrate into cotton each spring.

Accomplishments Through Fall 2002: The California Department of Food Agriculture's (CDFA) Biological Control Program has been actively importing and releasing *Peristenus* spp. (Hymenoptera: Braconidae) over the last five years. The United States Department of Agriculture, Agricultural Research Service (USDA-ARS) and CABI Bioscience explorers have collected parasitoids in southern France, northern and central Italy, and eastern Spain and south to the province of Granados (Table 1). Parasitoids, shipped as cocoons, have been sent to either the USDA-ARS quarantine facility in Newark, Delaware, or the Agriculture Agri-Food Canada quarantine in London, Ontario. Both agencies stored cocoons through the winter, then reared and cleared the adult parasitoids for shipment to the CDFA in Sacramento, California. Collections have been made in increasingly more southern sites, starting with southern France then moving to southern Spain, which matches most closely with the climate of central California.

The CDFA has reared *Lygus* sp. and *Peristenus* spp. following methods developed by the USDA-ARS in Newark, Delaware and others. Parasitoids received from these two quarantine facilities were either released directly into study plots of alfalfa or reared for future release. We received approximately 100 to 500 parasitoids each summer. Approximately 1,100 parasitoids were released in fall of 1998, then 6,000, 15,000, and 14,710 during summers 1999, 2000, and 2001, respectively. Almost 20,000 were released in 2002 (Table 2). However, over half of these were parasitized nymphs moved from our Sacramento release site. They have been released at 11 locations, from Kern County in the south to University of California, Davis in the north (Table 3). By maintaining year-round production of parasitoids in Sacramento, the overall numbers of parasitoids released each year, as well as initial field releases earlier in the year have increased. The earlier in the summer that releases are made, the greater the number of parasitoid generations produced, and hence, the higher the probability for permanent colonization. Most populations of *P. stygicus* and *P. digoneutis* were released at most sites. After four years, releases of *Peristenus* spp. ceased at the first release site (North B Street, Sacramento, CA) summer 2001.

## Table 1. Locations for Releases of Parasitoids, 1998 to 2001

| Species and Population Released Country (Province, nearest City) | Location Released | Lat/Long | | Year Released |
|---|---|---|---|---|
| *Peristenus stygicus*, France (Hérault, Lattes) | North B Street, Sacramento | 38º35.607'N | 121º29.519'W | 1998<br>1999<br>2000 |
| | UC/USDA, Shafter | | | 2000 |
| *Peristenus stygicus*, Italy (Veneto, San Dona' di Piave) | UC, Davis | 38º32.403'N | 121º45.919W | 1999<br>2000 |
| | UC Kearney Ag Center | | | 2000 |
| *Peristenus stygicus*, Spain (Cataluña, Navata) | Fong's Farm, Yolo County | 38º41.145'N | 121º53.574'W | 1999<br>2000 |
| | Sander's Farm, Kern County | | | 1999<br>2000 |
| | Triple S Farms, Merced | 37º08.508'N | 120º18.604'W | 2000<br>2001 |
| *Peristenus stygicus*, Italy (Umbria) | UC/USDA Shafter | 35º31.952'N | 119º16.701'W | 2000<br>2001 |
| | North B Street, Sacramento | 38º35.607'N | 121º29.519'W | 2001 |
| | UC Kearney Ag Center | 36º35.863'N | 119º30.646'W | 2001 |
| | Poplar Avenue, Kern2 | 35º33.4'N | 119º17.64'W | 2001 |
| *Peristenus stygicus*, Spain (Andalucia, Granada) | Triple S Farms, Merced | 37º08.508'N | 120º18.604'W | 2001 |
| | Madera | 36º59.54'N | 120º20.724'W | 2001 |
| | Poplar Avenue, Kern2 | 35º33.4'N | 119º17.64'W | 2001 |
| | Castroville | 36°46.012 | 121°42.887 | 2002 |
| *Peristenus digoneutis*, (Veneto, San Dona' di Piave) | North B Street, Sacramento | 38º35.607'N | 121º29.519'W | 1999 |
| *Peristenus digoneutis*, Italy (Umbria) | North B Street, Sacramento | 38º35.607'N | 121º29.519'W | 2001 |
| | UC/USDA, Shafter, main | 35º31.952'N | 119º16.701'W | 2000<br>2001 |
| | Poplar Avenue, Kern2 | 35º33.4'N | 119º17.64'W | 2001 |
| | Madera | 36º59.54'N | 120º20.724'W | 2001 |
| | Coast, Santa Cruz | | | 2001 |
| *Peristenus digoneutis*, Spain (Catalognia) | Coast, Santa Cruz | | | 2001 |
| | Castroville | 36°46.012 | 121°42.887 | 2002 |
| | UC/USDA, Shafter | 35º31.952'N | 119º16.701'W | 2002 |
| | UC Kearney Ag Center | 36º35.863'N | 119º30.646'W | 2002 |
| | UC, Davis | | | 2002 |

**Table 2. Peristenus Field Release Data Summary, 2002**

| Site | *P. stygicus* | | *P. digoneutis* | | |
|---|---|---|---|---|---|
| | Granada, Spain Released | Umbria, Italy Released | Catalonia, Spain Released | Nymphs Transferred | Total Insects Released |
| **Castroville** | 0 | 100 | 776 | 1,056 | 1,932 |
| **UC KAC** | 703 | 0 | 268 | 4,603 | 5,574 |
| **Madera** | 204 | 0 | 0 | 0 | 204 |
| **Merced** | 316 | 0 | 0 | 0 | 316 |
| **SREC** | 0 | 0 | 0 | 1,778 | 1,778 |
| **SREC-Main** | 0 | 441 | 419 | 540 | 1,400 |
| **SREC-S40** | 674 | 0 | 344 | 1,400 | 2,418 |
| **UC, Davis** | 57 | 596 | 1,101 | 4,450 | 6,204 |
| **Total** | 1,954 | 1,137 | 2,908 | 13,827 | 19,826 |

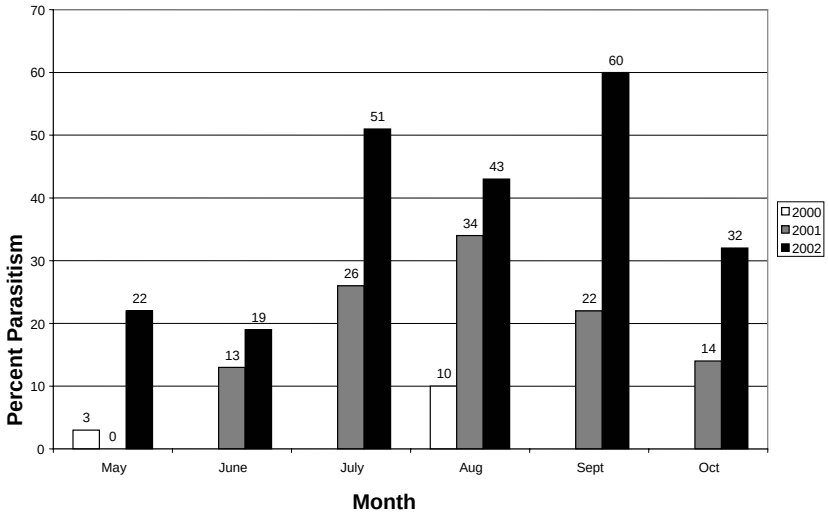
Results of recoveries at our first release site in Sacramento are encouraging. *Peristenus* were first recovered in May 2000. Each subsequent year parasitism levels have climbed at this location reaching a high of 60 percent in September 2002 (Figure 1). Both *P. stygicus* and *P. digoneutis* were recovered, over 16 months after the last releases at this location. Identities were verified by Henri Goulet (Ottawa, Ontario, Agriculture and Agri-Food, Canada*). P. stygicus* was dominant at the beginning of the summer, but both species were equally represented by October 2002. This is the first report of *Lygus* nymphal parasitoids successfully persisting and building in population size, in California. Furthermore, these two species have been firmly established.

**Table 3. Recoveries of Released Parasitoids**

| | Maximum Parasitism (n) | | |
|---|---|---|---|
| **Location** | **2000** | **2001** | **2002** |
| **Sacramento** | 10.0 | 34.0(32) | 60.0 (30) |
| **UC Davis** | 0.0 | 4.0 (50) | 2.0 (50) |
| **Merced** | -- | 14.0 (7) | 0.0 (0) |
| **Madera** | -- | 59.0 (2) | 0.0 (14) |
| **UC Kearney** | 24.0 (25) | 12.0 (25) | 10.0 (40) |
| **UC/USDA Shafter1** | -- | 5.0 (17) | 0.0 (40) |
| **UC/USDA Shafter2** | -- | -- | 0.0 (40) |
| **Castroville**[1] | -- | -- | -- |

[1]releases-initiated summer 2002

**Figure 1. Percent Parasitism at Sacramento Site**




Recoveries at other locations have been less than that in Sacramento (Table 4). Although we have made overwintering recoveries at most of these sites, there have not been consistent increases in parasitism over the last three years. There may be several reasons for these results. One may be current alfalfa management practice. We have recently learned that the parasitoids overwinter as cocoons below the duff of alfalfa. The alfalfa at our Sacramento release is cut, not baled. Thus a rich organic layer has built up over the last four years. Alfalfa at all other release sites has been baled, thus sites have little mulch, which stabilizes soil microhabitat, important to many ground dwelling predators. In January, we sampled for overwintering *Peristenus* in this plot. One adult *Peristenus* spp. emerged per 1.2 square feet of duff sampled. Both *P. stygicus* and *P. digoneutis* were recovered (6:4). Also, flood irrigation may be a problem in contrast to sprinkler irrigation, as used at our Sacramento site (parasitoids form cocoons in soil). Cultural practices such as alternate cutting and planting of nearby insectary flowers (present at the Sacramento site) may also contribute to differences in establishment of parasitoids. Climate could be a deciding factor. Sacramento between 100 and 300 miles north of the other release sites has somewhat cooler summers and wetter winters. Lastly, more time may be needed. Parasitoids were not recovered until five years after releases were made on the east coast.

While it appears these parasitoids will only survive in California under conditions described above, their initial colonization may depend on optimal conditions for year-round survivorship. Therefore, success at the original release site in Sacramento warrants additional effort in this direction.

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[2]USDA-ARS Newark, Delaware